Comparative thresholds for acetylcholinesterase inhibition and behavioral impairment in coho salmon exposed to chlorpyrifos.

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Chlorpyrifos is a common organophosphate insecticide widely detected in surface waters providing habitat for Pacific salmon in the western United States. Although chlorpyrifos is known to inhibit acetylcholinesterase (AChE) in the brain and muscle of salmonids, the relationship between sublethal AChE inhibition and more integrative indicators of neurobehavioral impairment is poorly understood. This is particularly true for exposures reflecting the typical range of pesticide concentrations in the aquatic environment. To directly compare the effects of chlorpyrifos on AChE activity and salmon behavior, we exposed juvenile coho salmon (Oncorhynchus kisutch) to chlorpyrifos (0 - 2.5 ppb) for 96 h. A computer-assisted, three-dimensional video system was used to measure spontaneous swimming and feeding behaviors in control and chlorpyrifos-exposed fish. Following the behavioral trials, brain and muscle tissues were collected and analyzed for AChE activity. Chlorpyrifos inhibited tissue AChE activity and all behaviors in a dose-dependent manner. Benchmark concentrations for sublethal neurotoxicity were < 0.5 ppb and were similar for both neurochemical and behavioral endpoints. Moreover, brain AChE inhibition and reductions in spontaneous swimming and feeding activity were significantly correlated. Collectively, these results indicate a close relationship between brain AChE inhibition and behavioral impairment in juvenile coho exposed to chlorpyrifos at environmentally realistic concentrations.